



ON TEST RADAR REFLECTORS »

Can you see me?

How effective are radar reflectors? We looked at 10, costing between £15 and £499, testing them in a lab and at sea. The results, as Toby Hodges finds out, were startling

You're crossing the channel. Fog descends and there's no coastline to hug, but ships are still ploughing the waters apart at up to 20 knots. Do you hope for the best or instead try and make the boat as visible as possible? Don't panic – a ship two miles away still leaves you about five minutes to decide!

Anything with metal in it will reflect radar. The Maritime and Coastguard Agency make radar reflectors mandatory safety equipment aboard all leisure vessels, but how effective are they? A reflector's job is to return as much of a radar pulse as possible to its source – to increase the reflective pattern of a vessel. But, imagine standing on the side of your yacht in a pitching sea with a mirror trying to return a random light signal coming from any angle

A fair reflection – the radar reflectors we tested varied enormously in size, shape and, consequently, effectiveness

– virtually impossible. Radar reflectors strive to compensate for the greatest coverage angles using a multitude of designs.

DESIGN GOALS

The best shape to return a radar pulse is a flat metallic plate – but only at one specific angle. The shape that gives most coverage consistency is a sphere, but these produce very weak returns. So the designer's challenge

Chamber of horrors? A typical anechoic chamber from Lun'tech in France

is how to achieve the best compromise between the two opposite shapes!

A reflector can, at best, only return the signal it receives. The larger its surface area, the better its chances. And the higher it is mounted the more efficient it is – but this adds weight, size and windage at the place you least want it.

So whether a reflector uses metal plates, high-tech spherical lenses, or powered active enhancers, the best design still has to cope with both pitch and yaw (heel angles), while keeping weight and windage down.

TYPES

Corner reflectors vary from the basic octahedral flat pack found in most emergency kits, to multiple corner reflectors using a stacked array of reflectors inside a plastic housing. Each corner reflector uses three flat plates intersecting at right angles for the greatest angles of incidence. Lens reflectors use spherical lenses to refract microwaves onto a reflective surface, producing a more consistent return. Active types use 12v power to amplify received waves before returning them.



JARGON BUSTER

RCS – Radar Cross Section relates to a reflector's performance, typically measured in decibels (dB) of return in relation to a metallic sphere with a cross sectional area of 1m^2 (diameter of 1.13m).

SPDs – Single Polar Diagrams are computer generated from tests on radar reflectors in anechoic chambers. Each shows performance on a single plane with the reflector rotated through 360° (usually showing every 1°).

TPMs – A Target Pattern Map is a 3D version of an SPD. Whether they move by 1° or 20° either way, reflectors mounted on yachts are seldom on a level plane. A TPM shows horizontal and vertical results at different angles of heel, as a colour-intensity plot.

» BIG SHIP RADAR



Photo: Getty

Ships tend to carry both X and S-band radar. X-band operates at a frequency of 9.4GHz (with a short 3.2 cm wavelength) with S-band using approx 3GHz and a slightly longer 10cm wavelength. Ships' Masters generally prefer S-band during port approaches and confined waters because it offers a clearer picture, less affected by clutter. But the ARPA (Automatic Radar Plotting Aid) system operates on X-band – the frequency that non-commercial (leisure) sets use.

TESTING

Entire books could be written on testing radar reflectors – a subject to send shudders down the spine of anyone involved in such trials! Arguments revolve around which method you choose, how you present the results, what performance the reflectors should achieve and the intricate issue of a boat's own interference. We decided to concentrate on finding the reflectors' best performance under optimum conditions.

For lab tests we took them to QinetiQ in Funtington, West Sussex, used by the Ministry of Defence, major defence manufacturers and the British Standards Institute.

Chamber testing:

Anechoic chambers (see main photo) are the recognised method of testing reflectors. They eradicate any variables, allowing a reflective structure to produce its optimum designed results. How? The walls, floor and ceiling of a large room are filled with carbon-impregnated foam cones which help absorb any reflected microwave signals – stopping them pinging off the walls, like balls off snooker cushions.

Each reflector is placed on a non-reflective polystyrene plinth which can revolve and tilt.

Radar waves are transmitted on a continuous 'plane' wave at 9.4GHz (X-band frequency), while each reflector slowly rotates through 360° . But reflectors spend little time horizontal, so we then tilted each at 5° , 10° and 15° and repeated the recordings (over 20° the gunwale becomes immersed). The data received is recorded in decibels and displayed on a logarithmic scale before being converted into a more comprehensible m^2 linear scale.

Some experts insist that a TPM is the only fair method of assessing a reflector's

– these are the areas where your yacht is liable to be invisible.

Sea trials: Following the lab tests we took to the water for sea trials. Designers and scientists will tell you there are too many variables at sea to produce reliable, accurate results. Boats produce their own reflection (see 'Interference' sidebar on p80), water reflects, the density of air affects radar waves (namely precipitation and fog), and you are relying on eyeball comparison, not mathematical data. However, we wanted to see how each design would fare under the same conditions. We used a target vessel with low reflective properties – a RIB with a 4m wooden mast (the minimum

recommended mounting height) and mounting platform. A Broom 38ft motor cruiser with a Raymarine C-series radar was used as the tracking vessel.

Conditions were favourable: calm sea-state (0.5m swell), Force 3 wind, with good visibility and occasional sunlight. The optimum distance apart for the trials proved to be at $1\frac{3}{4}\text{nm}$ (viewed on 3nm screen range) – where we could still see the target vessel, and the weaker signals still appeared for a small amount of time.

Each reflector was mounted on the mast. The RIB then idled on full lock through 360° circles. The radar operators timed how long an echo appeared to produce a percentage of on-screen time, while noting how clear each echo was (results are given in the final comparison table, see p80).

During trials, we used the Sea-me active radar enhancer as a position marker for the RIB, as this produced a constant, reliable echo at this distance.

When a reflector was mounted, we deactivated the enhancer, so the trackers knew exactly where the target should be. We also had another known target (Lymington starter platform) on the screen as a comparison for echo strength.

'The 'nulls' between the peaks on the polar diagrams are the important values – where your yacht is liable to be invisible'

performance – giving 3D representations of results. So for the three more intricate and expensive passive reflectors (Firdell, Echomax and Tri-Lens), we produced TPMs as well.

What to look for: A reflector's optimal RCS value is achieved when a pulse gets a direct hit on a corner reflector, for example, producing a high, broad peak on the polar diagram. But the troughs or 'nulls' between these peaks are the more important values

» SEA TRIALS



LEFT: Mounting a reflector at full (4m) height. MIDDLE: The target boat at half mast. ABOVE: Timing the periods of echo.

ON TEST RADAR REFLECTORS

RESULTS: THE RADAR REFLECTORS

» ECHOMAX

RECOMMENDED
YACHTING
MONTHLY

£129



Designed by the late John Firth (the 'Fir' part of Firdell, who designed the original 1970s reflector, prior to the Blipper), Echomax produce a range of reflectors for yachts, commercial boats and buoys.

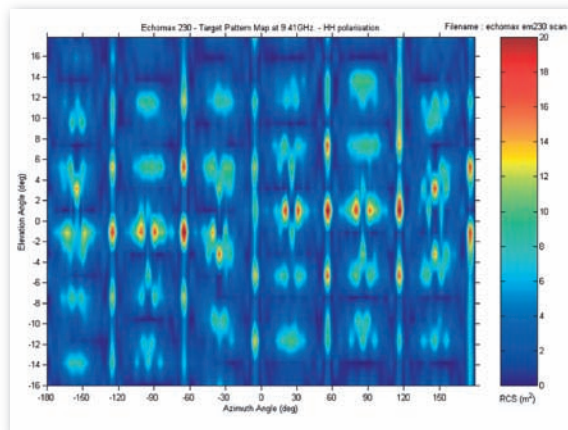
ECHOMAX EM230

The EM230 is one of very few reflectors to meet current ISO 8729 and SOLAS specification and has EU approval. Contained within the polyethylene case, designed to be mast or halyard mounted, is a triple layer of stacked array corner reflectors.

Chamber trials: The impressive peaks achieved when horizontal (24m²) show why it is the only model tested that complies with the ISO manufacturing specification, requiring peaks in excess of 10m². The peaks remain high (but sharp) during all heeling angles – but the average values are a lot better when vertical than heeled. The polar diagrams are mirrored by the TPM (left), where the dark red parts

represent the excellent peaks, but equally apparent are the dark blue (0-2m²) nulls.

Sea trials: When visible, the echoes were strong (indicative of these peaks) – but they were not quite as consistent as we'd hoped, with echoes apparent for less than half the recorded time. Bizarrely the smaller 'Basemount' version (below) achieved more reliable results, appearing on screen for longer.



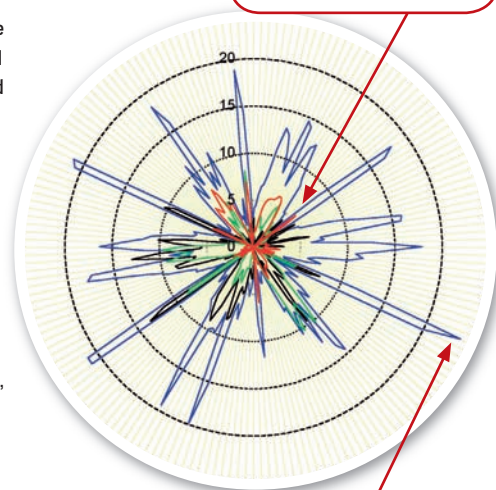
VERDICT

Outperforms its closest rival (the Firdell Blipper) and can produce impressive returns, but remains a large item to mount permanently for smaller yachts.

Contact: Echomax **Tel:** 01371 830216

Website: www.echomax.co.uk

Impressive values and coverage angles at 0°, but less so when heeled



ABOVE: Easily the best peak from the passive reflectors, giving 24m² at 0° heel.

BELOW: Also impressive, topping 20m², but these peaks are very fine

ECHOMAX 230 MIDI BASEMOUNT

Similar in design and weight to the EM230, the Basemount is slightly smaller and stockier and has a circular flat base, ideal for mounting on poles and arches.

Chamber trials: The results are similar to the EM230, with an impressive average and high

needle-peaks at 0°. Again, these both drop off when tilted, but remain distinctly better than poorer performers. Its smaller size is the only thing that keeps its average values below its big brother.

Sea trials: Gave good results on the water, with the third highest viewable percentage time behind the Tri-lens and Sea-me models.

VERDICT

While its smaller size limits its effectiveness, its size is a selling point for smaller boats. Good, tough all-round performer.

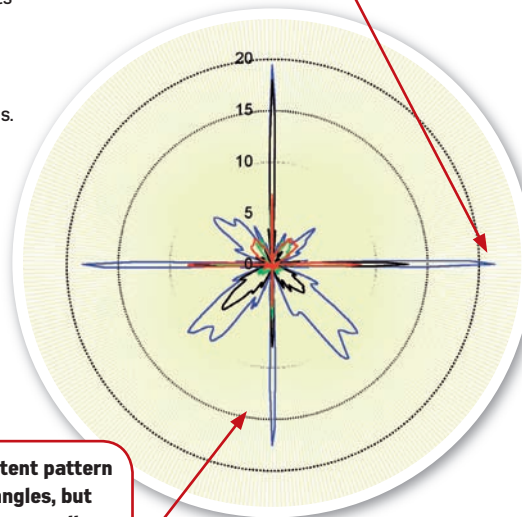
Contact: Echomax **Tel:** 01371 830216

Website: www.echomax.co.uk

£129



Consistent pattern at all angles, but some large nulls apparent between reflector plates



KEY TO POLAR DIAGRAMS

- 0°
- 5°
- 10°
- 15°

The polar diagrams represent the Radar Cross Section (RCS) values of each radar mounted at four different angles with the colour code (left) indicating

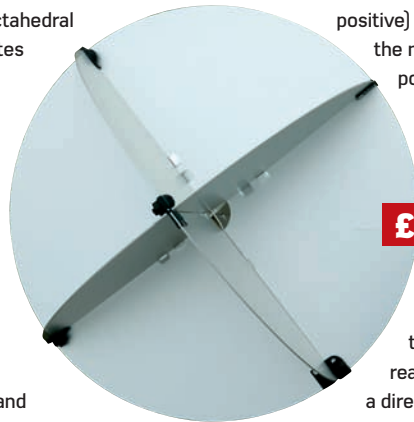
each angle of tilt. Ideally a pattern should be as large and as spherical as possible, avoiding any deep nulls (which can be blind spots).

The Target Pattern Maps (TPMs) have their own colour code alongside them and account for all angles for +/- 15° of heel.

» DAVIS ECHOMASTER

The Echomaster is an octahedral reflector with 6.25in plates using rounded edges to give slightly more reflective area than conventional types. Used extensively in the United States, it meets US Coastguard requirements. The anodised-aluminium plates pack flat and come in a plastic wallet with halyard harnesses and instructions to help mount the reflector in the 'catch rain' position.

Chamber trials: Lab tests on octahedrals typically produce a familiar petal-shape polar diagram – and this was very similar. From the diagram and results table, you can clearly see the peak returns on all four angles of heel, but also the large valleys or 'nulls' between the plates. Interestingly, the greatest returns are produced at 15° – yet so are the largest nulls (which are as detrimental as peaks are



positive) – so as the plates move from the more consistent 'catch rain' position to perpendicular, the radar gets good one-plane returns but less corner reflections. The average returns for all angles were proportionately smaller than the larger 16in octahedral.

£72

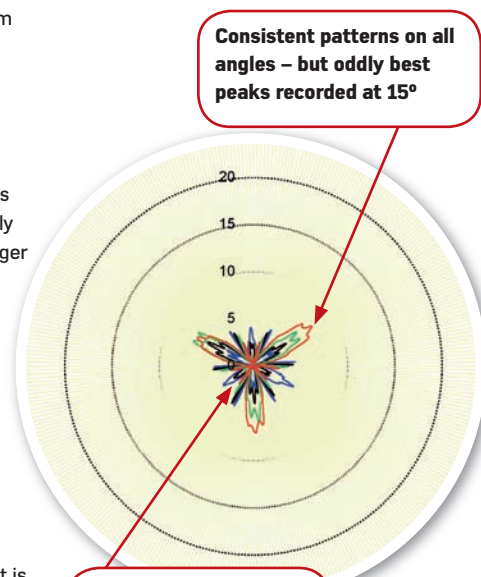
At sea: While the size of the largest echoes were reasonably bold (indicating a direct hit), we felt its sheer lack of surface area worked against it. A larger (16-18in) model might be more appropriate.

VERDICT

Needs to be larger. Failed to convince us that it is worth the extra expenditure over a conventional octahedral.

Contact: Mark Dowland Marine
Tel: 01929 551138

Website: www.burdengroup.com



Consistent patterns on all angles – but oddly best peaks recorded at 15°

These large nulls are typical of an octahedral design – with minimal response between the corner reflectors

» FIRDELL – 210-7

£129.95

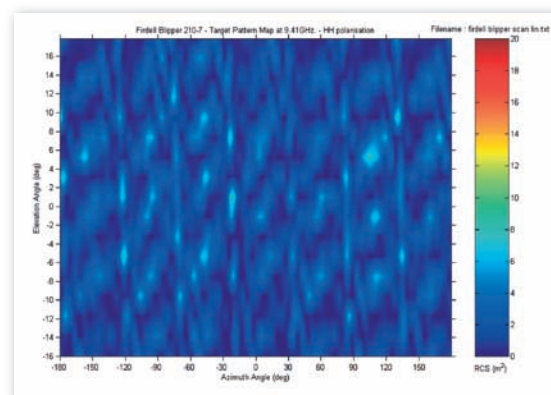


Take a look around most marinas and a lot of masts will sport Firdell Blippers – the most popular being the 210-7. Using a spiralling stack of trihedral corner reflectors inside a durable polyethylene cover, the majority are mast-mounted using stainless steel brackets. Firdell was reluctant to supply us with a test unit so we used the model from the tracking vessel.

Chamber trials: The

Blipper was designed to avoid the deep nulls associated with octahedrals. And to a certain extent the graph shows this has been achieved – offering reasonable peaks (8.53m² at highest), but more notably, less steep nulls than the octahedrals. However, the averages when heeled are slightly less.

Sea trials: Similar amount of returns



were gained to the Davis octahedral (17%) but were weaker in strength. The amount of time seen on screen was also disappointing.

VERDICT

Firdell have long been campaigners of TPMs – as a means of showing that stacked array reflectors produce more consistent 3D results on greater heel angles than octahedrals. We went to great lengths to produce TPMs, but the results for the Firdell (above) remained disappointing.

Some good peaks and void of deep nulls. Higher values would help inspire more confidence

ON TEST RADAR REFLECTORS >>

>> PLASTIMO

This French firm sell three types of reflector: Octahedrals, Tube-types and Visiballs.

OCTAHEDRAL 16in

Usually found neglected in the bottom of the cockpit locker, a flat-pack octahedral is what most sailors associate with a radar reflector. Also seen on channel marks and buoys, the octahedral is standard marine equipment.

Previous trials have shown a good response when a pulse hits a flat side, or a corner, but the nulls (blind spots), between are deep and wide.

Chamber trials: Of all the budget models, we felt the Octahedral fared the best – on all angles of heel. A maximum peak just shy of 8m² is admirable for a 16in model, but it's the average returns that remain consistent through to 15° of heel that pleased us.

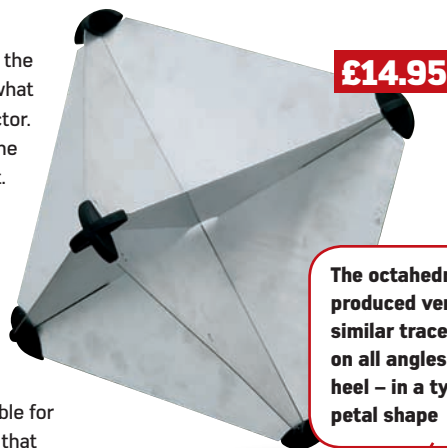
Sea trials: Completely true to the chamber test, the octahedral was visible just over 40% of the time, providing a moderate echo. It provided a good standard to judge others on – easily eclipsing other budget types.

VERDICT

At under £15 this is the cheapest model on test, yet it outperformed over half the others. As it packs flat, every yacht should carry one as a spare – preferably the 18in model – ready to hoist in bad conditions.

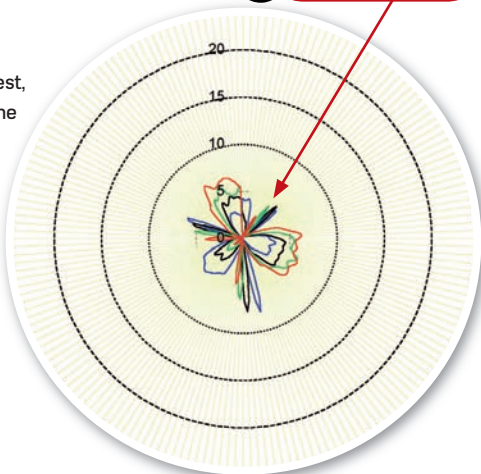
Contact: Navimo UK **Tel:** 0870 751 4666

Website: www.plastimo.com



£14.95

The octahedral produced very similar traces on all angles of heel – in a typical petal shape

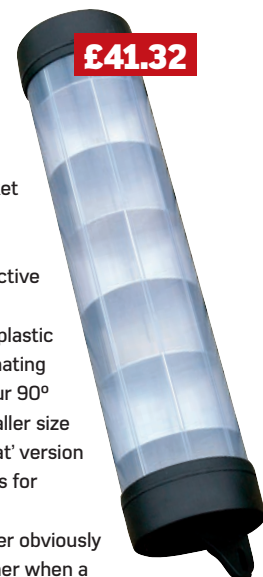


TUBE TYPE

Also known as the 'ice tray', this is very similar to the original Danish Mobri design (Mobri was unwilling to supply one for the test and no longer actively market them in the UK). This uses a multiple corner reflector principle – making the reflective plates much smaller and spiralling them up in a long plastic tube. There are seven alternating angled 'floors', each with four 90° trihedrals. Available in a smaller size and two models, the 'sailboat' version has a groove in the end caps for shroud mounting.

Chamber trials: The designer obviously thought he was onto a winner when a single horizontal polar diagram was first produced at 0° – impressive peaks (maxing at 9.3m²) with a good average value of (2.62m²) would do wonders for sales literature. However, when tilted the Tube produces a poor performance. At 15° the radar manages to find some small corner pockets to respond (as an octahedral would as it moves to 'double catch rain'), however unreliably.

Sea trials: Even mounted vertically in calm conditions, the Tube was only visible for up to four seconds in a minute, with a couple of average echoes.



£41.32

>> TRI-LENS

Available in 'Mini', 'Standard' and 'Large' sizes, the Tri-lens uses three bulbous plastic-covered reflectors containing premium-quality Luneberg lenses (as used by the French and US military). These stepped-index lenses can focus radar waves from most angles (horizontal and vertical) onto a reflector cap to produce consistent returns. Tri-Lens has been sold for the last three years in the UK by Viking.

The responses are relatively small (average 2m²), but remarkably consistent on all angles of heel

STANDARD TRI-LENS

Recommended for use on all sailboats, these come with mounting brackets and fit snugly around a mast, shading minimal coverage angles (the literature promotes 2–4m² for 330°).

Chamber trials: The trials for both the Standard and the larger Tri-lens were of particular interest, as we hadn't previously seen independent reports. The results back up the maker's claims. While one peak broke the 5m² barrier, it's the sheer consistency of the responses that won our praise. Look at how all three angles produce a near mirror image to the horizontal – remarkably consistent, with the only notable nulls (and peaks) occurring in the three small gaps



£109.99

RECOMMENDED
YACHTING
MONTHLY

between lenses.

Sea trials: Good consistent echoes of reasonable clarity were produced for almost 70% of the time – in keeping with its polar diagram.

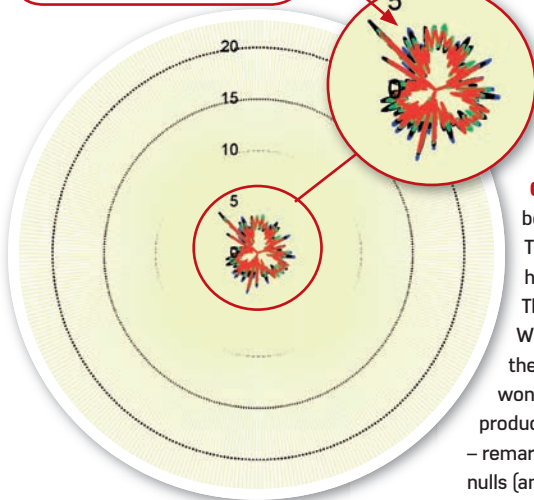
VERDICT

A solid performer. Its weight and price pitch it against the stacked arrays of Echomax and Firdell, but its compact size and consistent performance probably help it clinch our vote.

Contact: Viking Life-Saving Equipment Ltd

Tel: 02380 454 184

Website: www.viking-life.com

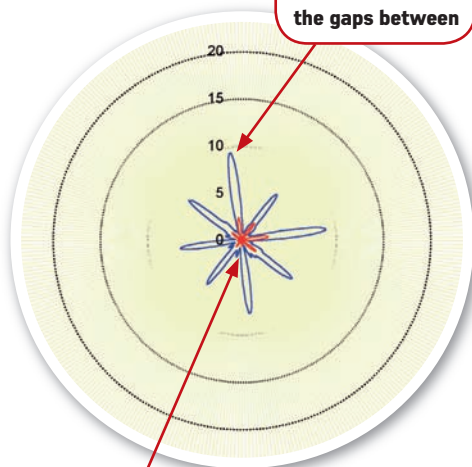


VERDICT

Cheap, light and offers less windage – but unfortunately has very limited reflective properties! Designs such as this may claim a '4m² reflective area' – but in reality, this means little to the average user.

Contact: Navimo UK **Tel:** 0870 751 4666
Website: www.plastimo.com

The Tube peaked at 9m² – but note the gaps between



While there's some response at 15°, traces from other angles of heel don't even appear on this scale

VISIBALL

Small and compact, this is designed for masthead mounting, with a flat platform on the base, and another on the top to mount a tri-colour (with a hole through the centre for the wiring). Inside is an 'array of two multi dielectric lenses mounted back to back' – in theory these 'computer-generated surfaces will ensure a consistent performance through 360°, according to the sales blurb, but with one lens facing forward and the other aft, there's no reflection from the sides.

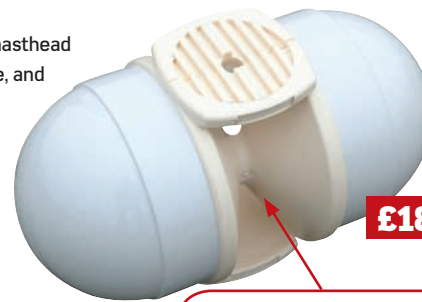
Chamber trials: The polar diagram virtually matches the Visiball's shape, with little more than zero response for up to 75° each side. To its credit, the results are consistent for all four trial angles, but with such small (0.5m²) average values, this is largely irrelevant.

Sea trials: The Visiball proved visible, but only just – 5% of the time with a very faint echo.

VERDICT

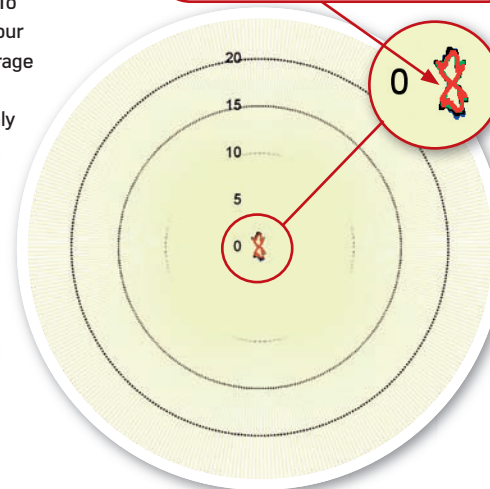
The compact design is good for a masthead, but lenses have to be bigger to be productive. This already weighs over 2kg – more than most would want at the top of their mast – especially if it's ineffective (and costs nearly £200).

Contact: Navimo UK
Tel: 0870 751 4666
Website: www.plastimo.com



£189

Although consistent when heeled, this produced the weakest responses – note how similar the diagram is to the design, with no echoes between the two spheres



LARGE TRI-LENS

Same shape, same principle – but on a larger scale. The brochure recommends this for use on vessels larger than 35ft; Viking's website states +42ft. Its 5.4kg weight would automatically confine it to the latter bracket.

Chamber trials: Like the smaller Standard Tri-Lens, the sheer consistency was impressive. Its average values remain in the +5m² figures at all

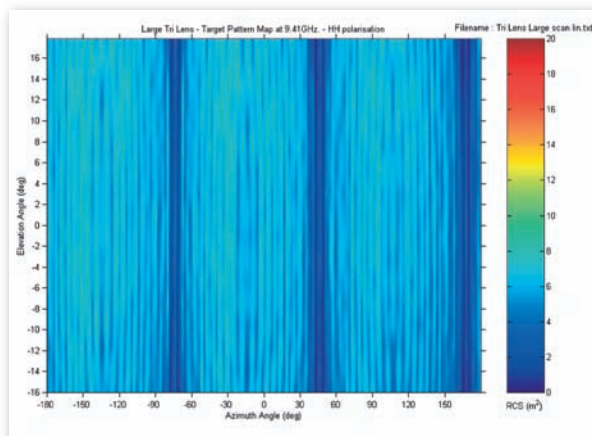
angles of heel. The three main nulls are situated exactly where the gaps between lenses are (120° apart) – however even these valleys are not too disturbing.

Sea trials: Produced the best passive reflector responses of the day. Echoes were strong and clear, with the reflector appearing on screen for a commendable 97% of the time.

VERDICT

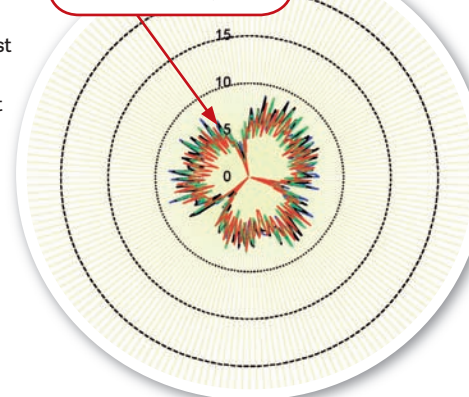
First-class results. At 5.4kg, though, this is nearly double the weight of the next heaviest performer. Few leisure yachtsmen would want ballast like that where it shouldn't be – but larger yachts (13m plus) would be wise to consider it at spreader level as it fits well around a mast.

Contact: Viking Life-Saving Equipment Ltd
Tel: 02380 454 184
Website: www.viking-life.com



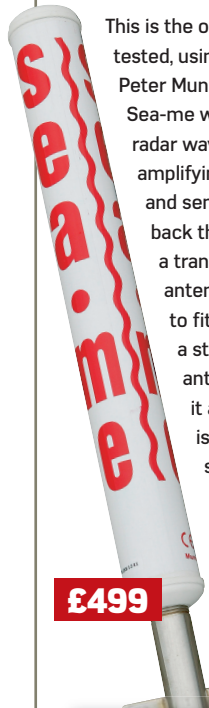
£109.99

Excellent coverage response on all angles with only three small nulls between spheres



ON TEST RADAR REFLECTORS

» SEA ME



£499

Just 41cm long, the Sea-me takes up little room in the rigging

PREMIUM PRODUCT
YACHTING MONTHLY

This is the only 'active' radar reflector we tested, using 12v power. Developed by Peter Munro of Munro Engineering, the Sea-me works by receiving X-band radar waves through an antenna, amplifying them and sending them back through a transmitter antenna. Easy to fit, using a standard antenna mount, it activates when a signal is received, uses 150mA in standby, and 360mA when transmitting.

Chamber trials: Fluctuations

'The results are impressive, with average values in triple figures'

seen in the diagram are the result of the efficiency of the antennas – if you could make them perfect, it would produce an exact sphere polar diagram. The results are impressive, with average values in triple figures.

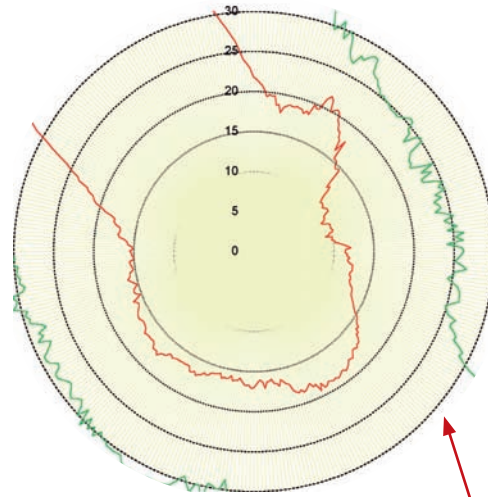
Sea trials: The Sea-me proved a useful 'marker' during the sea-trials while reflectors were swapped over. Because the echo is consistent and positive it was

also an excellent comparison for passive reflectors – none of which could match its strong echoes.

The Sea-me offers a point echo – so where ships' echoes on screen vary according to their size (because the same pulse hits the structure a number of times), the 'blip' of the Sea-me doesn't, but its brightness does.

VERDICT

Light, small, durable, easy to fit, with minimal windage, the Sea-me can be activated when needed. Its downsides are that it relies on power and carries a hefty price tag – although this is arguably proportional to its 'reflective' ability. The antenna only responds to X-band, so won't



The responses were so large that only the 10° and 15° heel angles start to show on this scale. Consistent through 360° with virtually no nulls evident. Average value on 0° was over 100m².

enhance a yacht on a ship's S-band system.

Contact: Munro Engineering Ltd

Tel: 01963 34184

Website: www.sea-me.co.uk

» LUN'TECH

THE PROTOTYPE

French firm Lun'tech, manufacturers of Luneberg lenses (as found in the Tri-lens), sent us a prototype of their most recent marine development. Unfortunately it arrived too late for our chamber trials. It uses a similar principle to the tri-lens, but is too large, heavy and expensive to be practical onboard a yacht. We hoped to include it in the sea trials, but at 9.5kg we couldn't mount it safely. Lun'tech

currently make similar reflectors for buoys and marks. Hopefully, technology will help reduce its size over time.

Price: £2,735

Contact: Lun'tech; www.luneberg.com

The polar diagrams we have seen from Lun'tech promise excellent performance, but this is not yet practical enough for yachtsmen



£2,735

NOTE: Cyclops Technologies were invited to supply reflectors for the test. They have new versions coming on the market to replace their range (1, 2 and 3), but could not get a prototype to us in time for the test.

MAKE	MODEL	SIZE	WEIGHT	AVERAGE RADAR CROSS SECTION VALUES (m²) AT FOUR ANGLES OF HEEL				MAX RCS VALUE (m²)	TIME ON SCREEN (out of 60 secs)	AS %	CLEAREST ECHO	PRICE
				0°	5°	10°	15°					
Davis	Echomaster	359x352x19	750g	1.6	1.57	1.81	2.08	7.42	10.5s	17.5%	4/10	£72
Echomax	Basemount	432x245	2,300g	4.24	1.86	1.09	1.12	21.56	38.1s	63.50%	6/10	£129
	EM 230 +	610x248	2,400g	8.43	2.92	2.65	1.82	24.08	26.2s	44%	6/10	£129
Firdell	Blipper 210-7	595x240	1,800g	3.44	1.86	1.51	1.3	8.53	10.3s	17%	2/10	£129.95
Plastimo	Octohedral 16"	300x300x415	650g	2.4	2.28	2.27	2.36	7.99	25.1s	42%	3/10	£14.45
	Tube	590x100	900g	2.62	0.15	0.1	0.5	9.3	3.9s	6.50%	3/10	£41.32
	Visiball	260x140x145	2,124g	0.53	0.52	0.48	0.47	1.49	3s	5%	1/10	£189
Trilens	Standard	305x152	2,490g	2.2	2.13	1.94	1.86	5.39	41.5s	69%	5/10	£109.99
	Large	508x203	5,400g	5.75	5.72	5.4	5.13	8.95	58.4s	97%	8/10	£299.99
SeaMe	Enhancer	410x50	410g	104.63	76.05	40.92	20.46	308.27	60s	100%	9/10	£499

Concluded on p80 →

ON TEST RADAR REFLECTORS >>

>> INTERFERENCE

Interference is a fundamental problem with radar reflectors. Most objects will reflect radar waves in some way. The sea itself has good reflective properties. A boat is made up of a multitude of reflectors – from engine, to stanchions to cooker (neither GRP nor aluminium masts tend to give consistent echoes) – all of which can disturb the path of a radar pulse. Putting a reflector near other sources of reflection (ie. the boat) therefore induces interference – which can unfortunately be either positive or negative.

CONCLUSION

Ships radars are heavily reliant upon ARPA (Automatic Radar Plotting Aid), which needs more than a 50% return to fix a target, and to keep it locked. Over half the reflectors tested appeared on our screen for less than 30 seconds each minute, two for less than five seconds. But these trials were using a RIB not a yacht – focussing only on the reflector's performance.

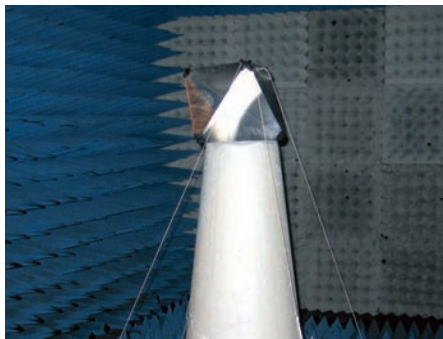
Historically, the octahedral reflector has been used as a benchmark for standardising reflectors. The two we tested performed adequately – but this could say more about the alarming results of poorer designs,

'Ships' ARPA systems need more than 50% return to fix a target and keep it locked'

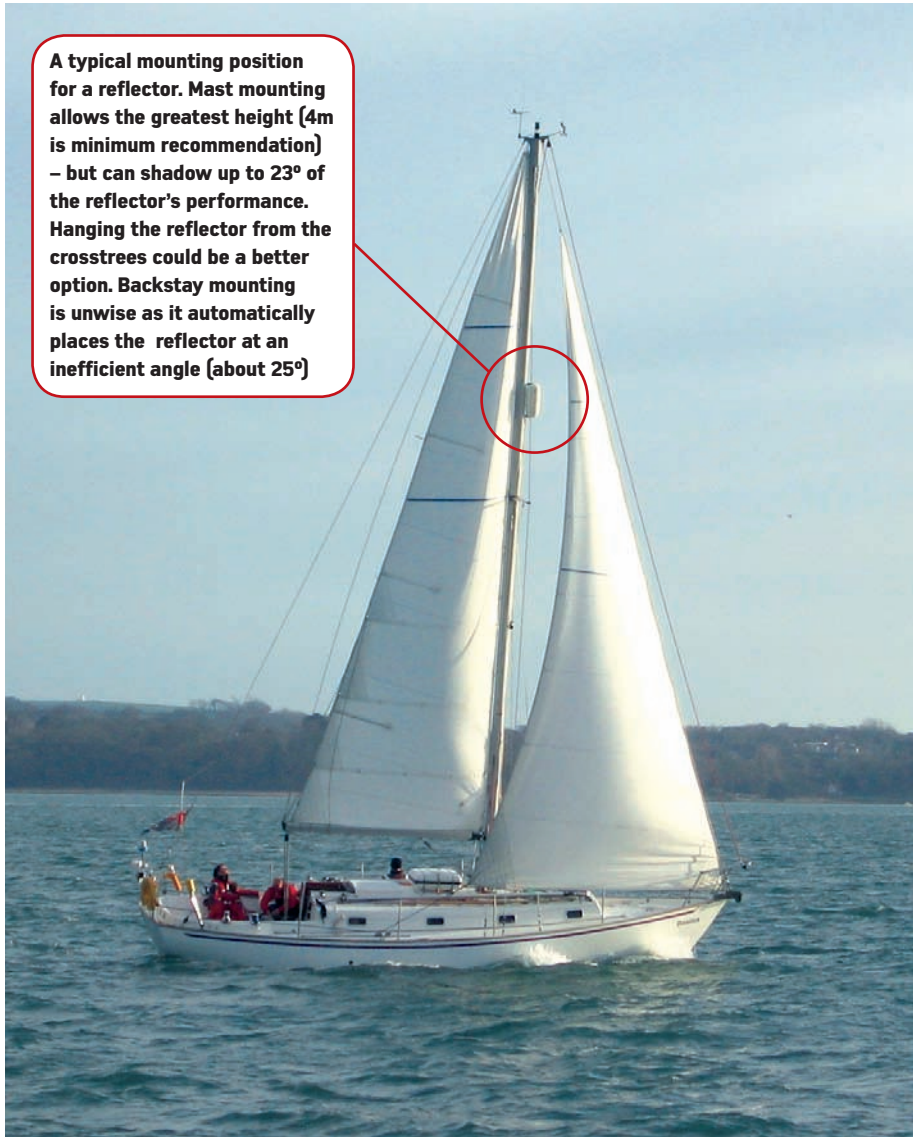
like the Tube type and Visiball. YM's box of crumpled tin foil did produce a response in the chamber, but with an average value of 0.04m2, we wouldn't place any faith in home-made reflectors.

We went to great lengths to produce Target Pattern Maps as part of our lab tests for the Echomax EM230, the Large Tri-lens and the Firdell Blipper. These proved that if you are willing to spend more money on a reflector, the Echomax and Tri-lens are more effective than a typical flat pack octahedral – especially when heeled. Stacked array types performed well – of which this large Echomax easily won

An octahedral being rigged up in Funtington's chamber



A typical mounting position for a reflector. Mast mounting allows the greatest height (4m is minimum recommendation) – but can shadow up to 23° of the reflector's performance. Hanging the reflector from the crossrees could be a better option. Backstay mounting is unwise as it automatically places the reflector at an inefficient angle (about 25°)



our vote, though some disturbing nulls (weak signals) were still in evidence. The Firdell Blipper was disappointing.

Two real positives emerged from our test – the Tri-lenses and the Sea-me. While weight (5.4kg) is the enemy of the Large Tri-lens, the Standard model produces a small but reliable RCS pattern. Size and weight will, it is hoped, reduce further in time and become even more practical for the small yacht.

In our increasingly congested waters a Sea-me makes excellent sense – while it can't yet be seen on a ship's S-band screen, it gives the best chance of being conspicuous with X-band Radar.

>> KEEP IT LEGAL

SOLAS V requires all small craft to fit a radar reflector 'if practicable'. Where it is not practicable to fit one that meets IMO requirements, yachtsmen should fit reflectors with the greatest echoing area practical as high as possible.

The current technical standard (meeting IMO requirements) for radar reflectors is ISO 8729, stating reflectors should produce maximum echoing areas of at least 10m² and responses over 240° of not less than 2.5m² for ±3°. In our tests, the Echomax 230 is the only reflector that currently satisfies these requirements.

THANKS

QinetiQ, formally part of the Government's Defence Evaluation Research Agency (DERA, now QinetiQ) have had a site at Funtington since 1940, when they were researching radar antennas to provide early warning of air attacks. The next 20 years saw development of VHF and microwave antennas, radar systems and precision tracking for guided missile ships.

DERA once designed a hi-tech antenna that rotated so fast it flew 300 yards onto the local cricket pitch! More recently the agency has been involved in stealth technology.

YM would like to thank Steve Luke, Senior RCS & Antenna Measurement Engineer and Matt Payne for their assistance.

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